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A BEGINNER'S GUIDE TO ACCIDENT INVESTIGATION

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PREFACE

Occupational accidents are investigated for various reasons: to fulfill the legal requirement, to determine the cost of accidents, or to ascertain compliance with applicable safety regulations. However, in the context of this document, it is assumed that accident investigations are conducted to find out what happened and why, in order that steps can be taken to prevent a recurrence.

Ideally, an investigation would be conducted by someone expert in accident causation, experienced in investigative techniques, fully knowledgeable of the work processes, procedures, persons, and industrial relations environment of a particular situation. Unfortunately, such persons are hard to find. Especially in smaller organizations, both workers and supervisors with little, if any, previous investigative experience may be called upon to participate in an inquiry.

This pamphlet is intended as a beginner's guide, to be used, for example, by newly appointed supervisors or joint occupational health and safety committee members. Note that these individuals may have an advantage over outside investigators in that they probably are more knowledgeable about the work processes, procedures, persons, and industrial environment. By reading the guide, discussion of its contents at safety committee meetings, and reference to it during the actual investigation, it is hoped that it will allow those who investigate accidents to concentrate on the accident's details rather than the investigation procedure itself.

The more experienced safety practitioner is not likely to find new material here. No attempt has been made to discuss the many models of accident causation and their corresponding methods of investigation. At best, a safety coordinator might find that this document has some use as an aid in safety training.

Investigations vary in scope, depending on the severity or potential severity of the consequences of the accident. As used here, the term "accident" is defined as an unplanned event that interrupts the completion of an activity, and that may (or may not) include injury or property damage. Incidents which entail no injury or

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damage still merit investigation to uncover hazards which should be corrected. The same principles apply to a quick oral inquiry of a minor incident as apply to the more formal investigation of a serious event. Therefore, a general framework based on these principles will be discussed.

ACCIDENT CAUSATION

An investigator who believes that accidents are caused by unsafe conditions will likely try to uncover them as causes; one who believes they are caused by unsafe acts will attempt to find human errors which are causes. In other words, general ideas of accident causation guide an investigator's work. Therefore, it is necessary to examine briefly some of these ideas on the underlying factors in a chain of events which culminates in an accident.

The first point to be made is that even in the most seemingly straightforward accident, seldom, if ever, is there only a single cause. For example, an "investigation" which concludes that an accident was due to worker carelessness, and goes no further, fails to seek answers to questions such as "Was the worker distracted?" "Why was the worker distracted?" "Was a safe work procedure being followed?" "If not, why not?" "Were safety devices in order?" "If not, why not?" "Was the worker trained?" "If not, why not?" and so on. This line of inquiry will probably reveal conditions which are more amenable to correction than attempts to prevent "carelessness." The quest for simple answers to a complex event such as an accident will do little to explain the causes and prevent recurrences.

Many models of accident causation have been proposed, ranging from Heinrich's domino theory to the sophisticated Management Oversight and Risk Tree (MORT). For articles describing these and other models, see page 14. The reader is urged to study as many of them as possible. The simple model shown in the figure (author's version, page 4) attempts to illustrate that the causes of any accident can be grouped into five categories -- task, material, environment, personal, and management. The model suggests that for any one accident, possible causes in each category should be investigated. Each category is examined more closely below. Remember that these are sample questions only, no attempt has been made to develop a comprehensive check-list.

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Task

Here the actual work procedure being used at the time of the accident is explored. You are looking for answers to questions such as:

1. Was a safe work procedure used?
2. Had conditions changed to make the normal procedure unsafe?
3. Were the appropriate tools, materials available?
4. Were they used?
5. Were safety devices working properly?
6. Was lockout used when necessary?

For most of these questions, a vital subsequent question is "If not, why not?"

Material

To seek out possible causes brought about by the equipment and materials used, you might ask:

1. Was there an equipment failure?
2. What caused it to fail?
3. Was the machinery poorly designed?
4. Were hazardous substances involved?
5. Were they clearly identified?
6. Was a less hazardous alternative substance possible and available?
7. Was the raw material substandard in some way?
8. Should personal protective equipment have been used?
9. Was it used?

Again, each time the answer reveals an unsafe condition, you must ask why this situation was allowed to exist.

Environment

The physical environment, and especially sudden changes to that environment, are factors which need to be identified. Note that it is the situation <u>at the time of the accident</u> that is important. For example, you may want to know:

1. What were the weather conditions?
2. Was poor housekeeping a problem?
3. Was it too hot or too cold?
4. Was noise a problem?
5. Was there adequate light?
6. Were toxic gases, dusts, fumes present?

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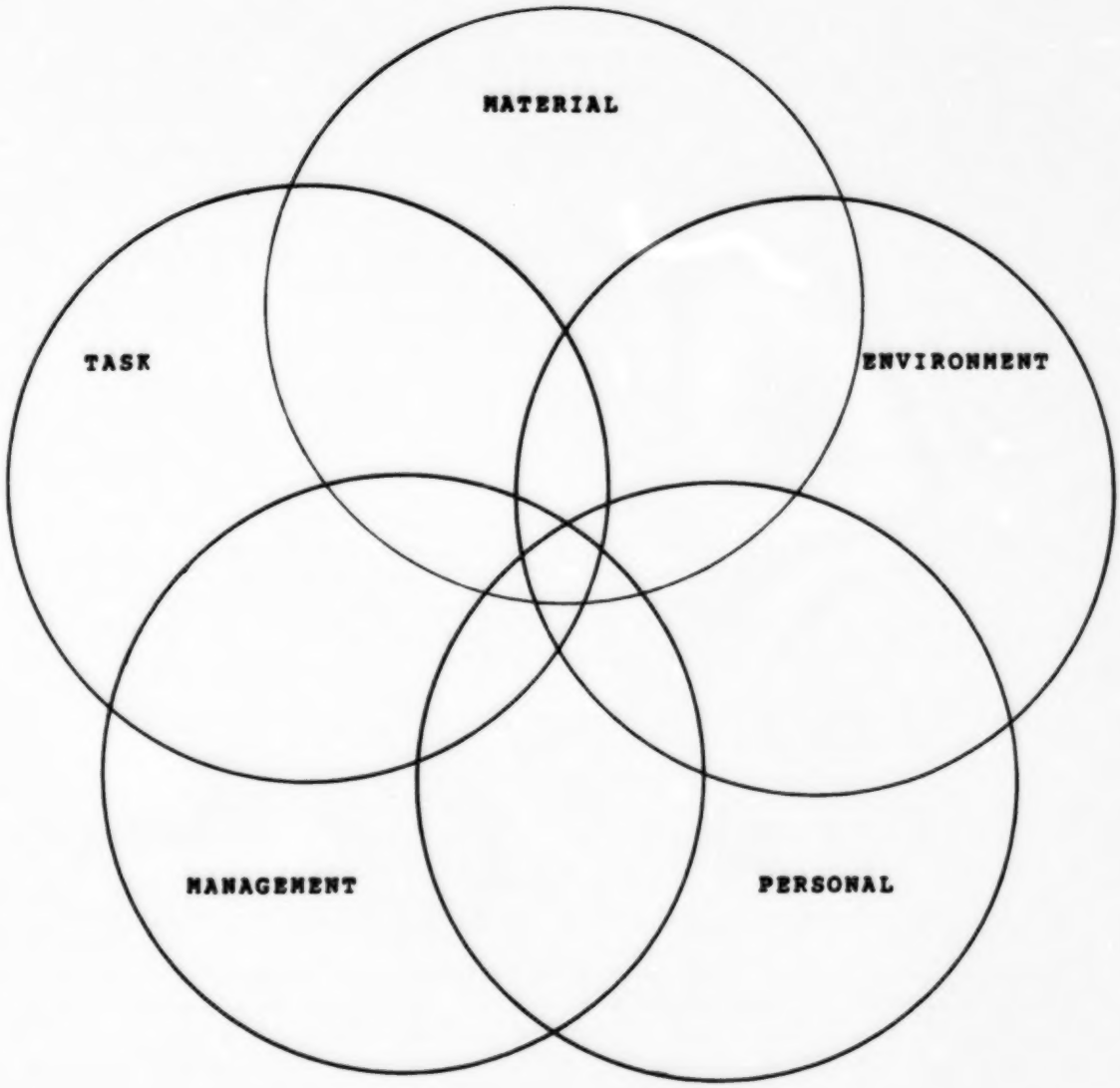

ACCIDENT CAUSATION

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Personal

The physical and mental condition of those directly involved in the incident must be explored. Bear in mind that you are not investigating the accident so that blame can be laid against someone; but your inquiry will not be complete unless you consider personal characteristics. Some factors will be more or less permanent; others may vary from day to day:

1. Were workers experienced in the work being done?
2. Had they been adequately trained?
3. Were they physically capable?
4. What was the status of their health?
5. Were they tired?
6. Were they under stress (work or personal)?

Management

Management holds the legal responsibility for the safety of the workplace and therefore the role of supervisors and higher management must always be considered in an accident investigation. Answers to any of the preceding types of questions logically lead to further questions such as:

1. Were safety rules in effect?
2. Were they being enforced?
3. Was adequate supervision given?
4. Had hazards been previously identified?
5. Had procedures been developed to overcome them?
6. Were unsafe conditions corrected?
7. Was regular maintenance of equipment carried out?
8. Were regular safety inspections carried out?

If you use this model as a guide in conducting your investigation, it should prevent you from looking at facts in isolation and assist you in trying to uncover <u>all</u> possible causes. You may not agree with the category into which some of the sample questions have been placed; this is not important, as long as each pertinent question is asked. It should have become evident that there is considerable overlap between categories; this reflects the situation in real life.

Again it should be emphasized that the above sample questions do not constitute a check-list, but are examples only. Check-lists are a valuable tool in many safety applications. Used as an adjunct to safety inspections, the chances are improved that no important item is left unchecked; as part of a safe work procedure (which in

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itself could be considered a master check-list), a worker is reminded to complete each step of the task. Although check-lists are in common use with accident investigators, you should realize their limitations. Each accident is a unique event, making it unlikely that any check-list can be made comprehensive enough to cover all possible causes other than in general terms. By relying on predetermined ideas, your free thinking may be inhibited. It becomes too easy to check off a few items which seem applicable and let it go at that. At one extreme, a list with a few items gives the impression that only a few causes have to be considered, while at the other end of the scale, a detailed multipage list may intimidate the investigator and lead to a waste of time in addressing irrelevant questions.

PRELIMINARY CONSIDERATIONS

At the outset, it was noted that accidents are investigated for various reasons. In this document it has been assumed that you are trying to find out what happened and why, so that you can make recommendations to eliminate hazards or conditions which may lead to similar occurrences in the future.

A difficulty which has bothered many investigators is the concept that one does not want to lay blame. How then can one honestly claim to have completed a thorough inquiry in cases where it has become apparent that some person or persons among management, supervisors, and workers were at fault? The simple answer is that where worksite accident investigations reveal individual failings, these are to be pointed out, but only to remedy the situation, not to discipline any individual. To fail to point this out will not only downgrade the quality of the investigation, but will also invite future accidents stemming from similar causes because they have not been addressed. On the other hand, using the information to discipline any individual will almost certainly result in future lack of trust and cooperation.

Another point of contention is who and how many people should investigate an accident. Some jurisdictions provide guidance, such as requiring that it must be conducted jointly, with both management and labour represented, or that the investigators must be knowledgeable about the work processes involved. Should the immediate supervisor be on the team? The advantages are that this person is likely to know most about the work and persons involved, the current conditions, and in many

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cases be able to take immediate remedial action. The counterargument is that there may be an attempt to gloss over the supervisor's shortcomings in the accident. This situation should not arise if the worker representative is able to express his own views freely, and management reviews all accident investigation reports critically. Since any number of people can be called as witnesses, it is probably best to limit the investigation team to a minimum for the sake of efficiency.

As little time as possible should be lost between the moment of an accident or near miss and the beginning of the investigation. In this way you are most likely to be able to observe the conditions as they were at the time, prevent disturbance of evidence, and identify witnesses. The tools you may need (pencil, paper, camera and film, tape measure, etc.) should be immediately available so that no time is wasted.

INVESTIGATION PROCEDURE

The steps in accident investigation are simple: you gather information, analyse it, draw conclusions, and make recommendations. Straightforward as this procedure seems, each step is not without its pitfalls. Keep an open mind to all possible causes as discussed in the first section; preconceived notions may lead you down the wrong path with significant factors left uncovered. Make notes of ideas as they occur to you but try to avoid drawing conclusions until all the information is gathered.

It goes without saying that rescue operations, medical treatment of the injured, and prevention of further injuries have priority and must not be interfered with. When these matters are under control, the investigators can start their work. Before attempting to gather information, examine the site for a quick overview, take steps to preserve evidence (in some jurisdictions, an accident site must not be disturbed without prior approval from appropriate government officials such as the coroner, inspector, or police), and identify all witnesses.

Physical Evidence

Physical evidence, although it is probably the most noncontroversial information available, may also be subject to rapid change or obliteration. For this reason, it should be the first to be recorded. Based on your knowledge of the work process, you may want to check items such as:

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- positions of injured workers
- equipment being used
- materials being used
- safety devices in use
- position of appropriate guards
- position of controls of machinery
- damage to equipment
- housekeeping of area
- weather conditions
- lighting levels
- noise levels

You may wish to take photographs, both of the general area and specific items -- later careful study of these may reveal conditions you missed at first. Sketches of the accident scene based on measurements taken may also assist your subsequent analysis and will clarify your written report.

Broken equipment, debris, and samples of materials involved may be removed for further analysis by appropriate experts. Make notes which will identify exactly where these items came from.

Eyewitness Accounts

Eyewitness accounts represent another source of information. Although there may be occasions when you are unable to do so, every effort should be made to interview witnesses. In situations where you are called upon to investigate an accident without being able to examine the scene immediately after the event, as often is the case, this may be your primary source of information. Because witnesses may be under severe emotional stress or reticent to be completely open for fear of recrimination, interviewing witnesses is probably the hardest task facing an investigator.

To get as untainted a version as possible, witnesses should be interviewed as soon as practicable after the accident. If witnesses have an opportunity to discuss the event among themselves, individual perceptions may be lost in the normal process of accepting a consensus view where doubt exists about the facts. For this same reason, witnesses should be interviewed singly, rather than in a group. You may decide to interview a witness at the scene of the accident, where it is easier to establish the positions of each person involved and description of the events is facilitated, or in the peace and quiet of an office where there will be fewer distractions.

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Interviewing is an art which cannot be given justice in a brief document such as this, but a few do's and don'ts can be mentioned, bearing in mind that you want to establish rapport with the witness and whose own words you want for a description of the event:

DO
- put the witness, who is probably upset, at ease
- emphasize the real reason for the investigation
- let the witness talk
- confirm that you have the statement correct
- try to sense any underlying feelings of the witness
- make short notes only during the interview

DON'T
- intimidate the witness
- interrupt
- prompt
- ask leading questions
- show your emotion
- make lengthy notes while the witness is talking

The actual questions you ask the witness will naturally vary with each accident, but there are some general questions that should be asked each time:

1. Where were you at the time of the accident?
2. What were you doing at the time?
3. What did you see, hear?
4. What were the environmental conditions (weather, light, noise, etc.) at the time?
5. What was (were) the injured worker(s) doing at the time?
6. In your opinion, what caused the accident?
7. How might similar accidents be prevented in the future?

Because you were not at the scene at the time, asking questions is a straightforward approach to establishing what happened. Obviously, care must be taken to assess the credibility of any statements made in the interviews. Answers to the first two suggested questions will give you an indication of how well the witness was able to observe what happened.

Another technique sometimes used to determine the sequence of events is to replay them as they occurred. Obviously, great care must be taken so that further injuries or damage are not incurred. A witness (usually the injured worker) is asked to reenact in slow motion his actions which preceded the accident.

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Background Information

A third, and often overlooked source of information can be found in documents such as technical data sheets, maintenance reports, past accident reports, formalized safe-work procedures, and training reports. Any pertinent information should be studied to see what light might be shed on what happened, and what changes might be recommended for the future.

Analysis and Conclusions

At this stage of the investigation you should pretty well know what happened and how it happened. Although this has taken considerable effort on your part, you have only fulfilled the first half of your objective. You now come to the key question -- why did it happen? To prevent recurrences of similar accidents you must find all possible answers to this question.

You have kept an open mind to all possibilities and sought out all pertinent facts. There may still be gaps in your tracing of the sequence of events which culminated in the accident. You may need to reinterview some of the witnesses to fill these gaps in your knowledge, or you may have to resort to assumptions. Some authorities claim that assumptions have no place in accident investigations. On the other hand, it seems better to make assumptions based on what evidence is available, than to leave questions unanswered.

Throughout your investigation you have kept in mind all the possible causes discussed in the first section of this document. In the analysis phase, you should go back and check to see if all possible causes <u>have</u> been considered. How do the management factors fit into the overall picture? In many investigations, this group of causes is not closely examined until the analysis phase. Now is the time to consider information only the immediate supervisor may be aware of -- was the worker fully trained on this task? Was there any indication of previous subnormal performance? Were there any signs of physical or mental stress? Had the worker been briefed on unusual circumstances? Was there a rush to complete the job? What safety training had been conducted?

When your analysis is complete, jot down a step-by-step account of what happened (your conclusions), working back from the moment of the accident, listing all possible causes at each step. This is not extra work, it is a draft for part of your final report. Check each

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conclusion to see if it is supported by evidence, noting whether that evidence is direct (physical or documentary), or based on eyewitness accounts, or if it is based on assumption. This serves as a final check on discrepancies which should be explained or eliminated.

Recommendations

An investigation where the exact sequence of events has been established and all causal factors have been determined still does little for proactive accident prevention. The most important final step is to come up with a set of well-considered recommendations designed to prevent recurrences of similar accidents.

Because you are knowledgeable about the work processes involved and the overall situation in your organization, it should not be too difficult to come up with realistic recommendations. Resist the temptation to make only general recommendations in order to save time and effort. For example, you have determined that a blind corner contributed to an accident. Rather than just recommending "eliminate blind corners" it would be better to suggest:

1. Install mirror at northwest corner of building X (specific to this accident) and,
2. Install mirrors at blind corners where required throughout the worksite (general).

Never make recommendations about disciplining a person or persons who may have been at fault. To do so would not only be counter to the real purpose of your investigation, but it would jeopardize the chances for a free flow of information in future accident investigations.

In the unlikely event that you have not been able to determine the causes of an accident with any certainty, you still probably have uncovered safety weaknesses in the operation. It is appropriate that recommendations be made to correct these deficiencies.

The Written Report

If your organization has a standard format which must be used, you will have little choice in the form that your written report is to be presented. Nevertheless, you should be aware of, and try to overcome, shortcomings such as:

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- If a limited space is provided for an answer, the tendency will be to answer in that space despite exhortations to "use back of form if necessary."

- If a check-list of causes is included, possible causes not listed may be disregarded (in other words, the cause "other" is seldom used).

- Headings such as "unsafe condition" will usually elicit a single response even when more than one unsafe condition exists.

- Differentiating between "primary cause" and "contributing factors" can be misleading. All accident causes are important and merit consideration for possible corrective action.

Your previously prepared draft of the sequence of events can now be used to describe what happened. Remember that readers of your report do not have the intimate knowledge of the accident that you have, so include all pertinent detail. Photographs and diagrams may save many words of description. Identify clearly where evidence is based on certain facts, eyewitness accounts, or your assumptions. If doubt exists about any particular facet, say so. The reasons for your conclusions should be stated, followed by your recommendations.

Weed out extraneous material which is not required for a full understanding of the accident and its causes, such as photographs which are not pertinent and accounts of lines of inquiry that led you nowhere. The measure of a good accident report is quality, not quantity.

SUMMARY

Once the report has been submitted, the investigator's work is normally finished. To accomplish the main objective of the investigation, the prevention of future similar accidents, the recommendations must be implemented. Although the report will probably be discussed at a safety committee meeting and further recommendations might be made, the ultimate legal responsibility for corrective action falls on supervisors and management.

The suggested procedure for investigation is not complicated. Your skills will probably be put to test most severely when it comes to applying your knowledge of

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accident causation and interview techniques. Learn all you can about both and keep an open mind throughout. You should not expect to become proficient in accident investigation simply by reading these few pages, since competence in any skill can only be achieved by practice based on knowledge of the basic steps. If you succeed in finding answers to why things happen, you know that your efforts have not been in vain.

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